8 – Western Indiana
Exceptional Events Detail

Parameter: $PM_{2.5}$

Dates: May 23 – 25 & 29 – 31, 2007

Location: Terre Haute – Vigo Co.

Event: Smoke from wildfires in northern Florida and southern Georgia impacted the Terre Haute region during the period of May 23 – 31. The gradual buildup of smoke moving through the area during this period resulted in an exceedance of the 24-hour $PM_{2.5}$ NAAQS on May 29th at Terre Haute Devaney and several elevated levels throughout the region.

Data: Different analyses of the data are used to demonstrate that the $PM_{2.5}$ concentrations measured from May 23 – 25 and May 29 - 31 have been influenced by outside events. Table 8.1 shows daily $PM_{2.5}$ averages prior to, during and after the event with the values flagged in **bold**. Data have been flagged with an exceptional event flag of 'E' in AQS, awaiting concurrence from EPA.

Tables 8.2 and 8.3 list summaries of the data collected at the Terre Haute sites since 2000. Data from 2007 are calculated with all current data and with the flagged data removed.

Table 8.1 - FRM Daily Values
Exceptional Event Period

Values in **BOLD** are flagged as exceptional events

Date	Terre Haute – Lafayette Ave. 1816700181	Terre Haute Devaney 181670023
5/18/07	9.9	6.3
5/19/07		10.2
5/20/07		12.5
5/21/07	16	14.9
5/22/07		20.1
5/23/07		**32.6**
5/24/07	**28.8**	**27.7**
5/25/07		**30.4**
5/26/07		25.4
5/27/07	21.5	21.2
5/28/07		23.2
5/29/07		**39.6**
5/30/07	**29.2**	**29.6**
5/31/07		**30.5**
6/1/07		20.3
6/2/07	18	16.8

Table 8.2 - Historical Daily Values

Year		Terre Haute – Lafayette Ave. 1816700181		Terre Haute Devaney 181670023	
		98th %ile	Daily Design Value[1]	98th %ile	Daily Design Value[1]
2000		34.2		28.7	
2001		38.4		30.1	
2002	2000-2002	40.2	38	38.1	32
2003	2001-2003	35.3	38	35.4	35
2004	2002-2004	26.9	34	30.4	35
2005	2003-2005	43.1	35	42.5	36
2006	2004-2006	31	34	29.1	34
2007	2005-2007	31	35	32.2	35
		Values excluding flagged data			
2007	2005-2007	31	35	31.2	34

[1]Daily Design Value = 3 year average of annual 98th %ile values.

Table 8.3 - Historical Annual Averages

Year		Terre Haute –Lafayette Ave. 1816700181		Terre Haute Devaney 181670023	
		Annual Ave.	Annual Design Value[2]	Annual Ave.	Annual Design Value[2]
2000		15.7		13.8	
2001		15.2		13.4	
2002	2000-2002	14.5	15.2	13.4	13.5
2003	2001-2003	14.1	14.6	13.4	13.4
2004	2002-2004	12.7	13.8	12.1	13
2005	2003-2005	15.4	14.1	15.1	13.5
2006	2004-2006	13	13.7	12.2	13.1
2007	2005-2007	14.1	14.2	13.8	13.7
		Values excluding flagged data			
2007	2005-2007	13.8	14.1	13.4	13.6

[2]Annual Design value = 3 year average of the annual averages.

Particulate Composition: Speciated data are not collected at either Terre Haute site. The maps in Appendix 3 indicate that the regional organic carbon values were elevated on the two available sample days. The values were among the highest values recorded in 2007. The elemental carbon values on these dates remained at or below average values.

Trajectory Modeling: The NOAA HYSPLIT Models are used to show wind trajectories at different levels during this event. Backward modeling from the site (latitude: 39.49°; longitude: -87.40°) at elevations of 25m, 150m and 500m was conducted for a period of three (3) to four (4) days prior. The differing elevations were chosen to demonstrate the air mass's uniformity at ground-level where the samplers were located and aloft which avoids the ground-level limitations of the model. Forward modeling was conducted using the Bugaboo Scrub Fire as the starting point (latitude: 30.70°; longitude: -82.40°) at an elevation of 250 meters (appropriate height that is low enough to always be in the well-mixed zone and high enough to avoid the ground-level model limitation) and going three (3) to four (4) days. Overall, there is a very good correlation when comparing the forward and backward trajectories for a given date. For example, May 25, 29, and 30 show a very narrow channel of air flow between southeastern Georgia and western Indiana. Both the backward and forward trajectories confirm this although Forward trajectory modeling results are shown in Appendix 2.

Maps: Images of maps from NOAA Satellite and Information Services show the smoke plume originating from the northern Florida/southern Georgia region. Dispersion and movement of the smoke plume from these fires was generally to the west or northwest and then to the north. The daily satellite smoke photos show that the smoke plume from the fires comes into Indiana on May 23 and continues to influence the atmosphere until June 2. The daily wind roses generally track the direction of the smoke plume on that day at the local level. The daily wind roses generally track the direction of the smoke plume on that day at the local level. Meteorological data for the wind roses is from the West Union, Il monitoring site (170230001). NOAA weather maps are also used to show that an upper level trough greatly influences the direction of the plume in relation to the Western Indiana region.

Conclusion: EPA defines an "exceptional event" as an unusual or naturally occurring event that can affect air quality but is not reasonably controllable by state and local agencies. Exceptional events are events for which the normal planning and regulatory process established by the clean air act is not appropriate. It has been illustrated through the use of maps, meteorological data, speciation data, trajectory models and historical data that the smoke from wildfires in Florida and Georgia impacted the Terre Haute region during the period of May 23 – 25 and May 29 - 31, 2007 causing exceedances of the $PM_{2.5}$ 24-hour standard and significantly increasing the annual average. According to 40 CFR Part 50.14 (b)(1), "EPA shall exclude data from use in determinations of exceedances and NAAQS violations where a State demonstrates to EPA's satisfaction that an exceptional event

caused a specific air pollution concentration in excess of one or more national ambient air quality standards at a particular air quality monitoring location and otherwise satisfies the requirements of this section." IDEM believes they have successfully illustrated the impact of this event on the sites in this region.

Therefore, IDEM requests that EPA concur with the 'E' flag on the data in AQS for the data in **bold** in Table 8.1.

The smoke map shows that the plume has reached the Terre Haute area and as shown in Table 8.1, $PM_{2.5}$ levels have started to increase. The corresponding wind rose and weather map further illustrate the direction of the plume by the location of the upper level trough (orange dashed line) and the strong southerly prevailing winds.

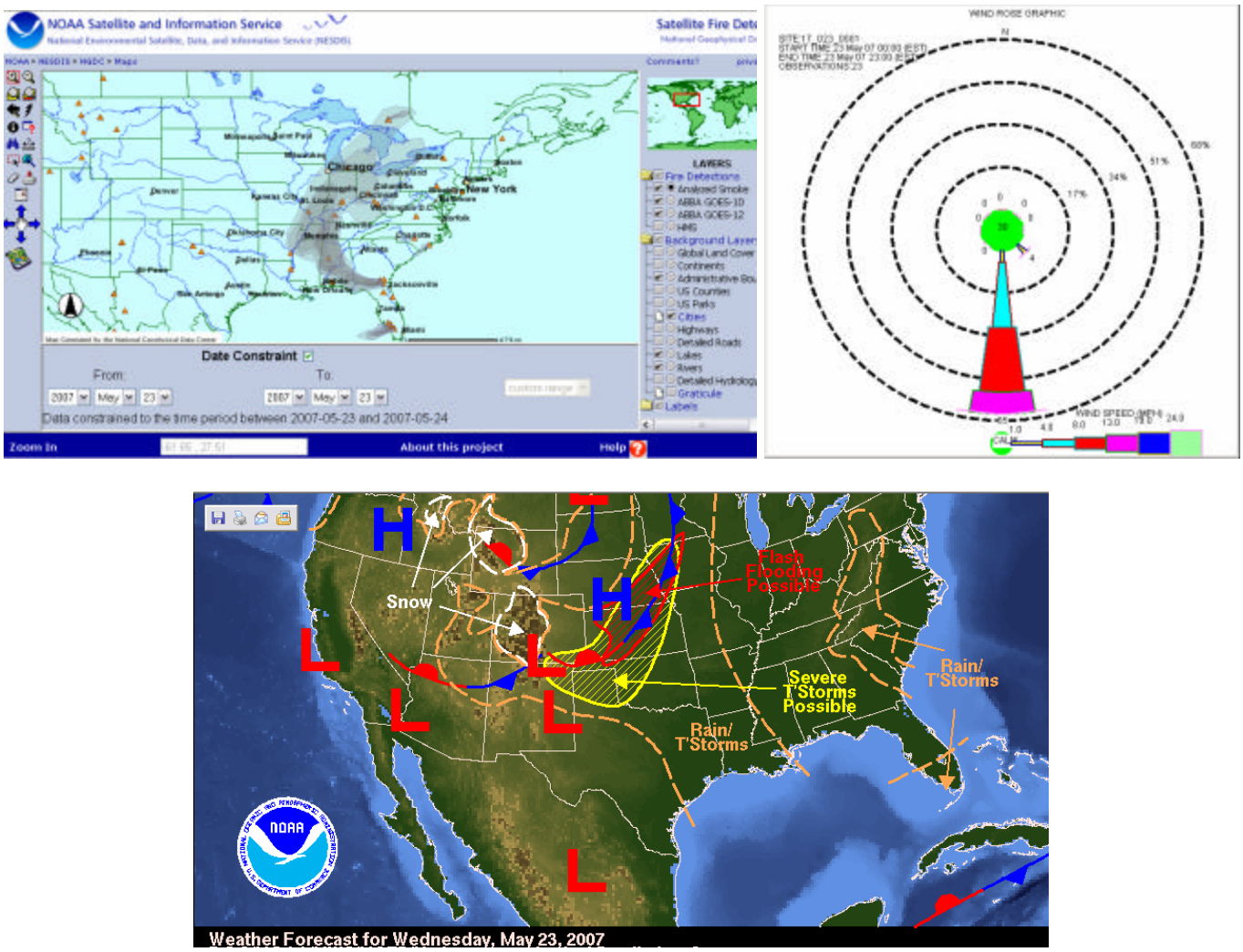
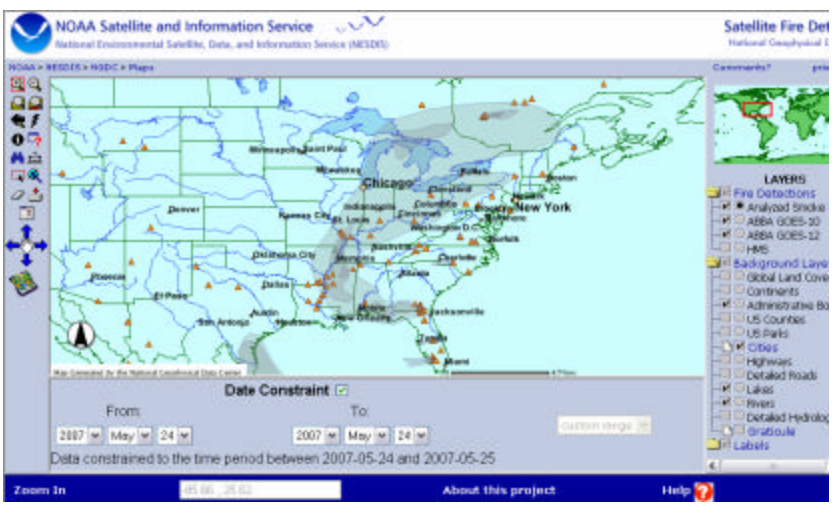
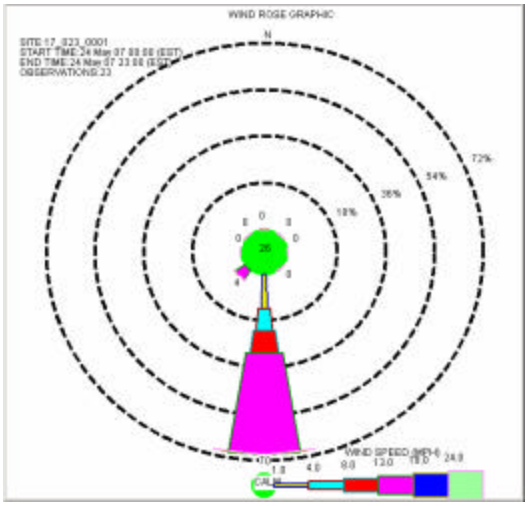


Figure 8.1 - May 23, 2007

The smoke map shows that the plume is remaining over the area. The prevailing wind direction remains from the south as the upper level trough moves further to the east and another trough develops over Ohio, keeping the plume over the western Indiana region.





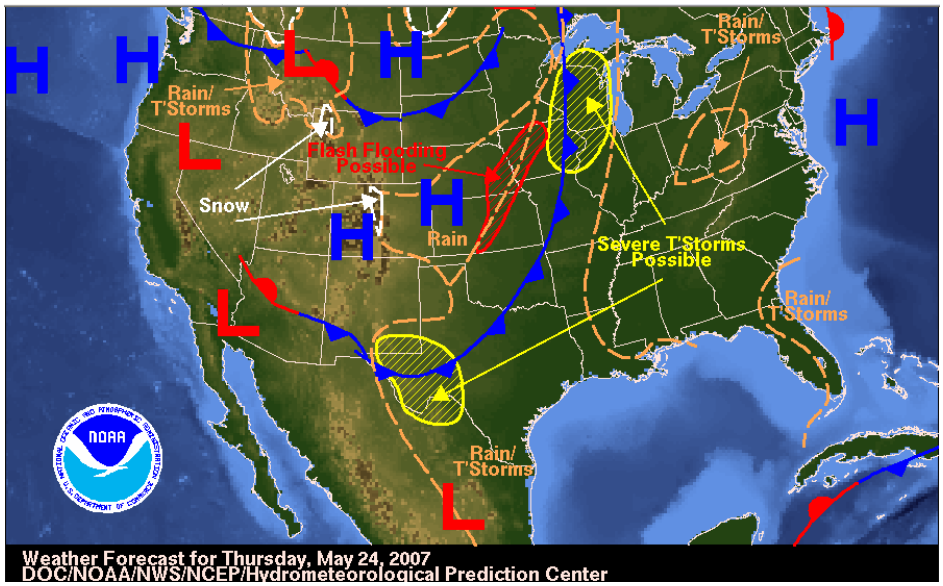


Figure 8.2 - May 24, 2007

The smoke map shows that the plume is remaining over the area. The prevailing winds are calm and from the SW as the upper level trough has now moved directly over the Terre Haute region.

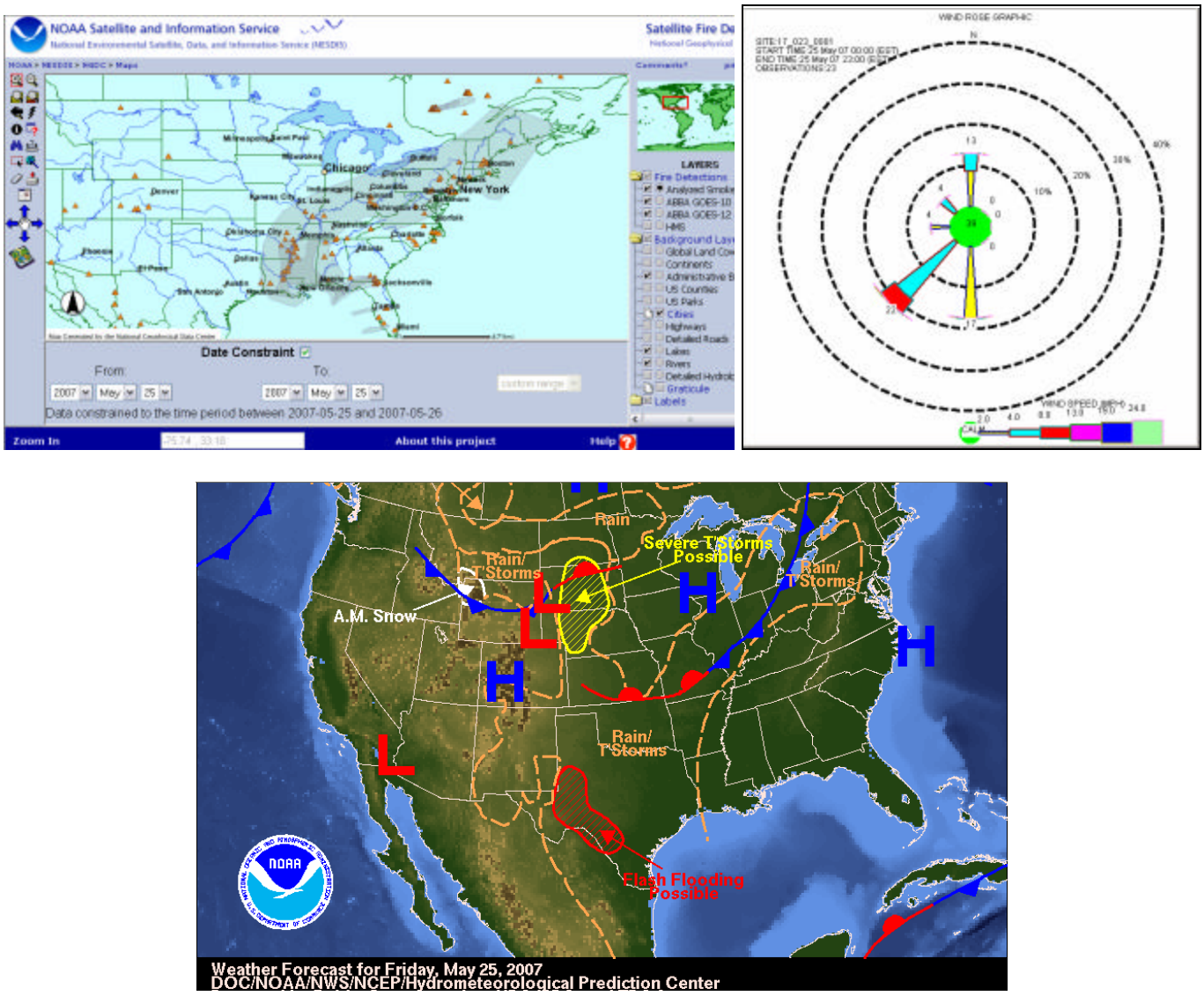
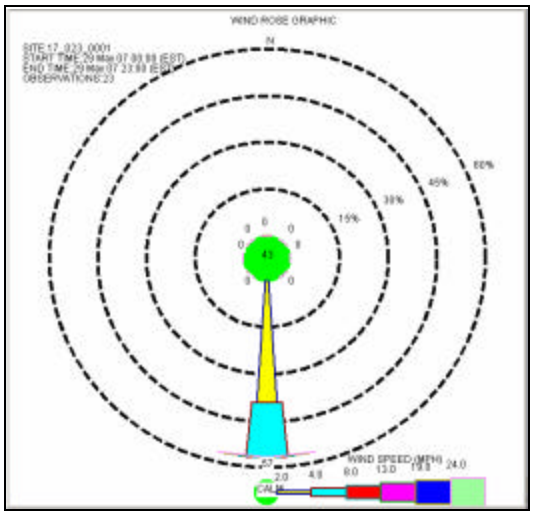


Figure 8.3 – May 25, 2007

Although the map illustrates the plume is not over the region, the prevailing calm wind conditions and southerly wind direction, as shown by the wind rose, keep the high levels of $PM_{2.5}$ over the area.



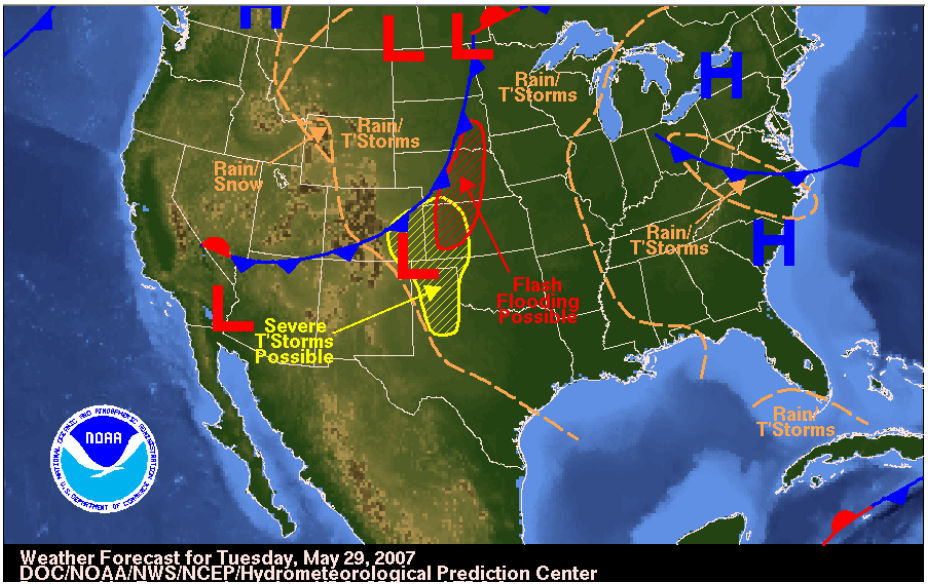
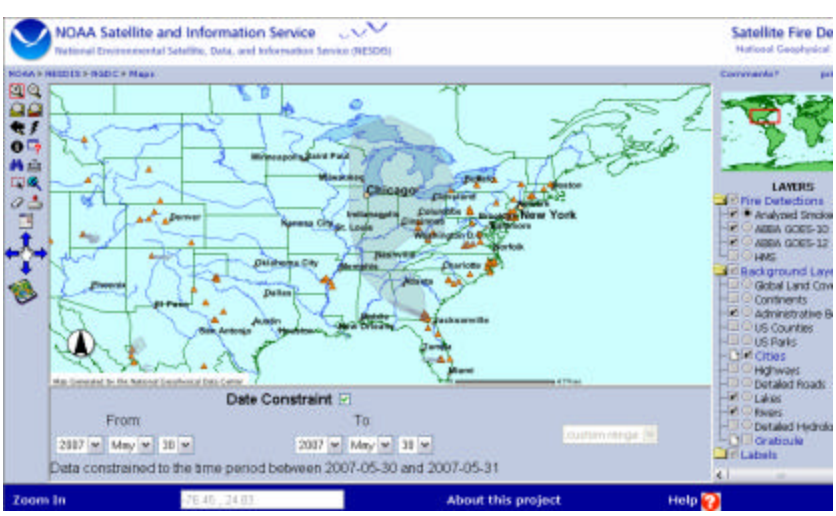
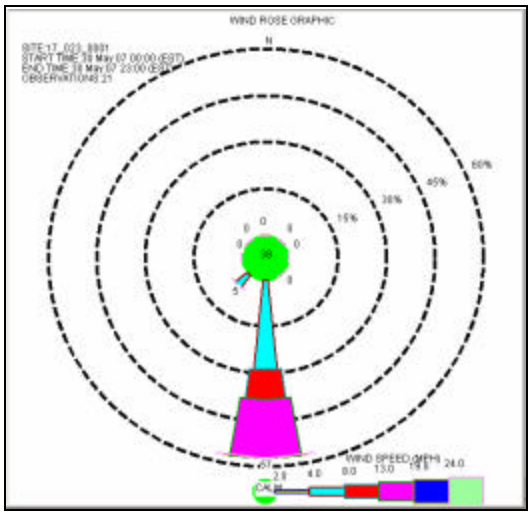


Figure 8.4 – May 29, 2007

The map shows the plume has moved back over the region as the upper level trough dips down over the area and the wind direction continues to be from the south.





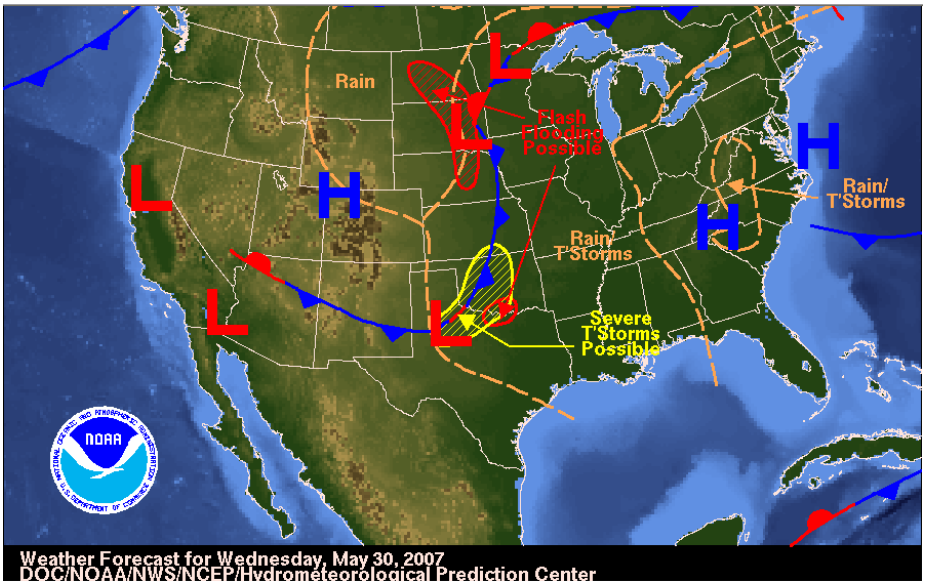
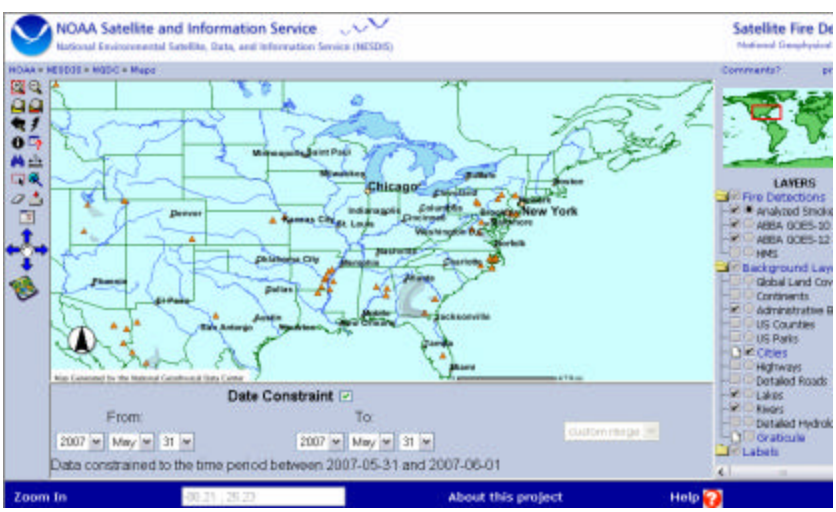
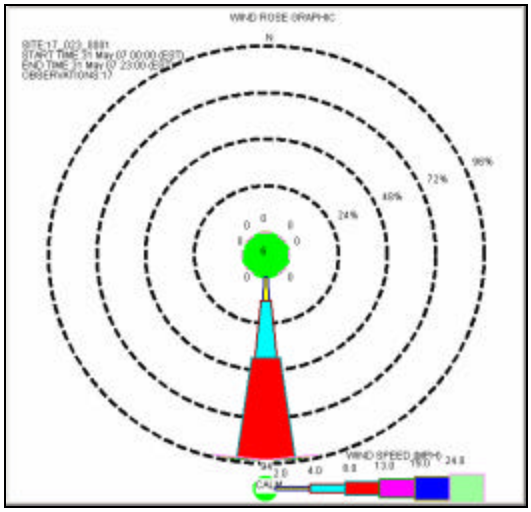


Figure 8.5 – May 30, 2007

The map shows the plume has dissipated as the upper level trough moves to the east. However, a strong southerly wind keeps the high levels over the area.





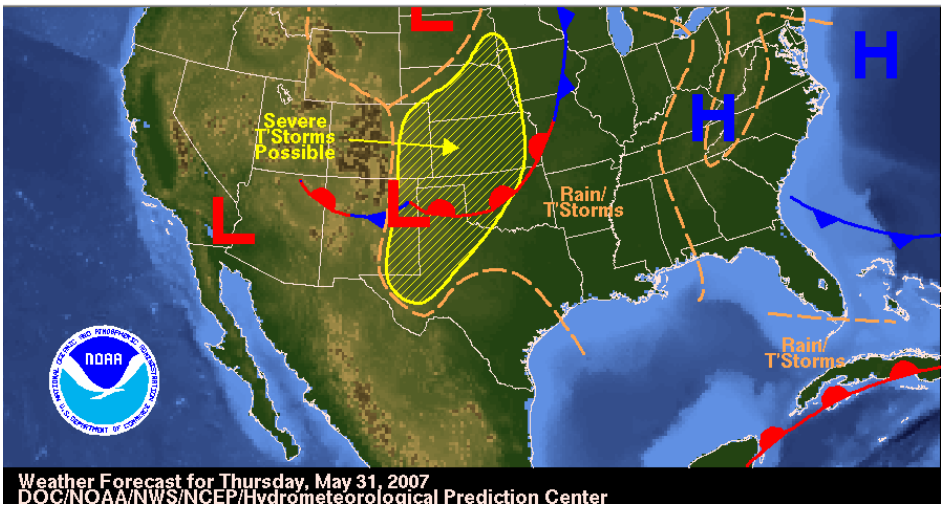


Figure 8.6 – May 31, 2007

Backward Trajectory Models

NOAA ARL READY HYSPLIT Maps

Draxler, R.R. and Rolph, G.D., 2003. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (http://www.arl.noaa.gov/ready/hysplit4.html). NOAA Air Resources Laboratory, Silver Spring, MD.

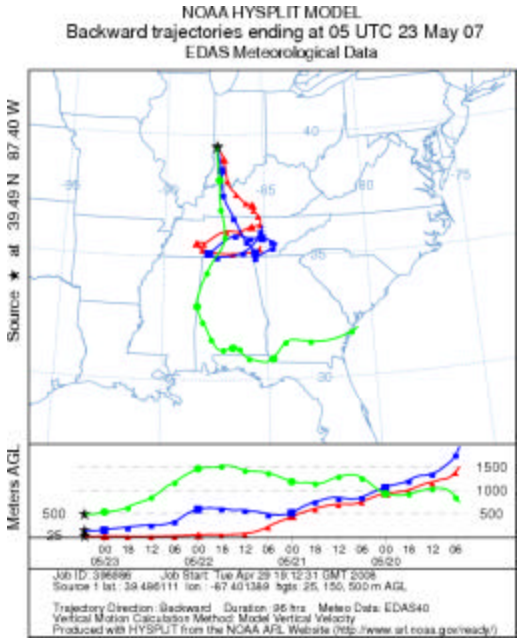


Figure 8.7: Backward trajectories originating from Terre Haute on 5/23/07 at 12:00 AM EST showing consistency in the air mass passing over southern Georgia.

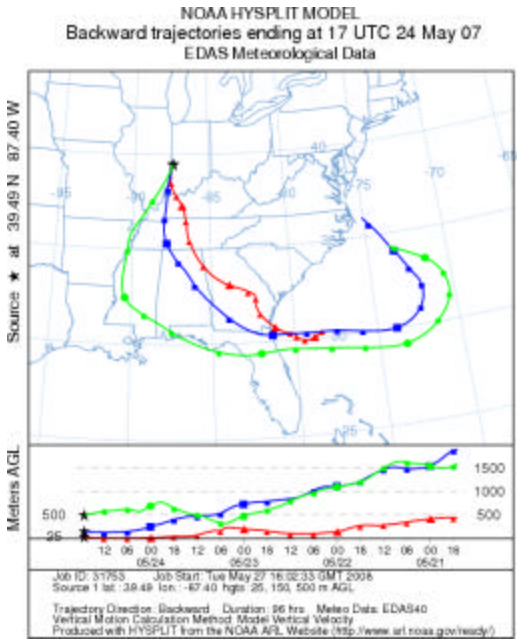


Figure 8.8: Backward trajectories originating from Terre Haute on 5/24/07 at 12:00 PM EST showing continuation of the air mass passing over southern Georgia and northern Florida.

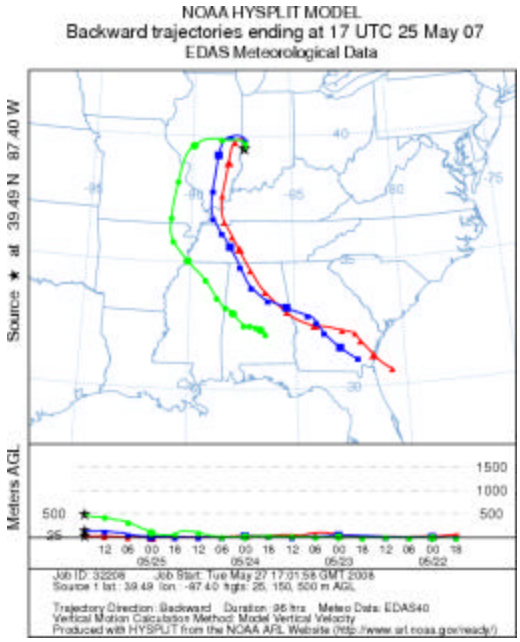


Figure 8.9: Backward trajectories originating from Terre Haute on 5/25/07 at 12:00 PM EST showing the air mass still passing over southern Georgia.

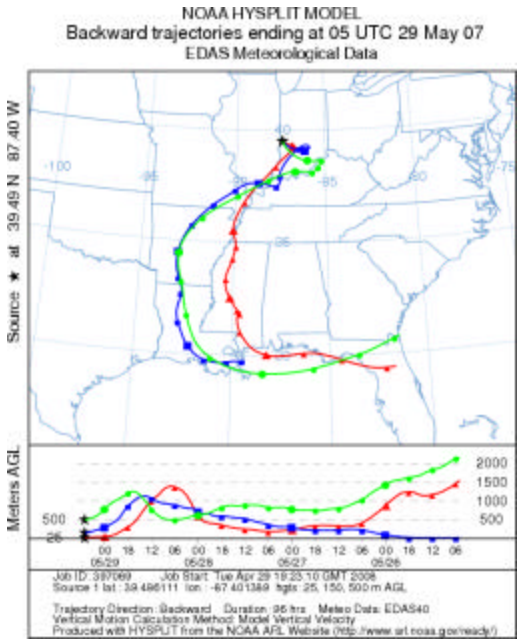


Figure 8.10: Backward trajectories originating from Terre Haute on 5/29/07 at 12:00 AM EST showing continuation of the air mass passing over northern Florida.

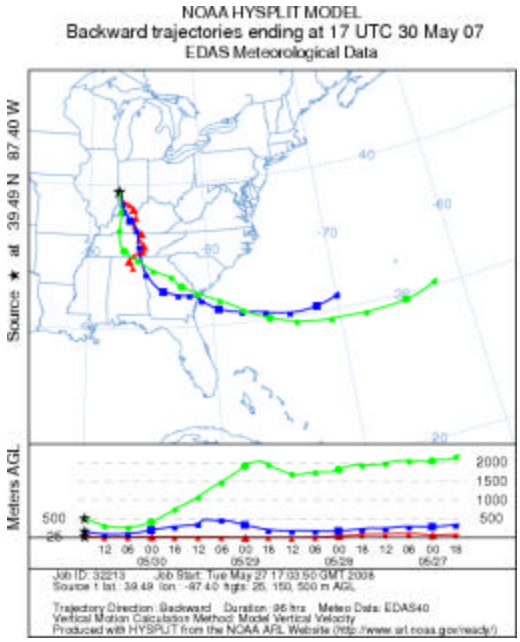


Figure 8.11: Backward trajectories originating from Terre Haute on 5/30/07 at 12:00 PM EST showing the air mass still passing over southern Georgia.

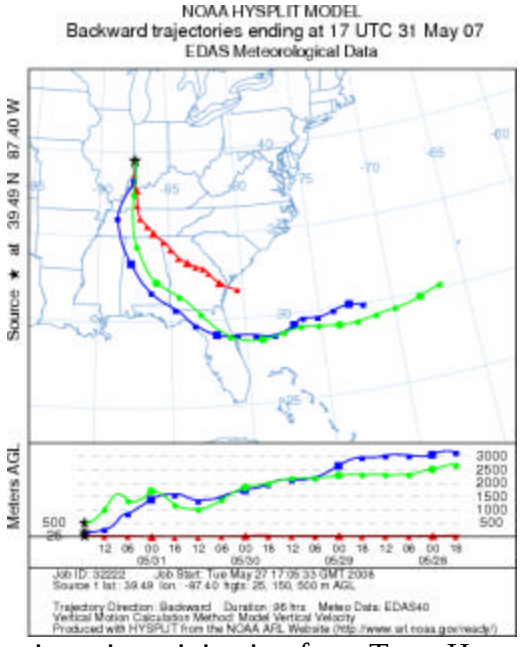


Figure 8.12: Backward trajectories originating from Terre Haute on 5/31/07 at 12:00 PM EST showing consistency in the air mass passing over southern Georgia and northern Florida.